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A STUDY OF GLACIOGENIC SEISMICITY AT THE JUTULSTRAUMEN GLACIER, ANTARCTICA

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The Jutulstraumen glacier is one of the three largest outlet glaciers in Dronning Maud Land, Antarctica, supplying the central part of the Fimbul Ice Shelf with a discharge of 14 Gt/year. This large outflux contributes to forming Trolltunga, a large ice tongue that extends seawards from the front of the glacier and which periodically calves and generates tabular icebergs. Near the ice shelf margin, the outlet flow direction is deviated by an ice rise, a grounded feature surrounded by floating ice shelf. This central part of the ice shelf moves much faster than the western and eastern parts, creating shear zones at their margins that exhibit intense crevassing and rifting.

At the eastern shear margin, close to the ice rise at the coast, a vast number of small magnitude seismic events were observed within the records of the seismic stations TROLL and SNAA, their source region estimated at an approximate distance of 180 km from the stations. This is an area downstream of the glacier's grounding line, where the ice sheet moves with speeds ranging between 100 and 400 meters per year. The thickness of the ice sheet in this region is estimated at about 200-300 meters, overlaying 300-700 meters of ocean water.

The observed seismic events are characterized by magnitudes that are larger than those of typical icequakes, which are only observable at distances of a few kilometres from the recording station. However, their distribution displays such regular occurrence patterns with the time of day as to make a tectonic origin highly improbable.

In order to obtain a more complete and detailed image of the temporal distribution of this activity, a waveform cross-correlation detector was employed on the records of TROLL and SNAA for 2 master events of high signal-to-noise ratio. Manual inspection of the results helped to define correlation coefficient thresholds to safely associate detections with this activity. A large number of events exhibit strikingly high waveform similarity, suggesting a narrow source region and a uniform focal mechanism. The use of the detector resulted in a population of more than 2700 events between March 2013 and January 2014, although few events were also detected during the preceding time interval, from February 2012 on, when station TROLL was installed.

Further investigation of the temporal evolution during the main activity interval revealed two distinct phases; one phase between March and July 2013 with a gradually increasing event occurrence rate, and a later stage, from August 2013 to January 2014, of much more intense activity, with inter-event times of 8 ± 2 minutes. In addition, this second phase exhibits a clear bi-weekly periodicity, suggestive of tidal modulation.

The characteristics of the observed seismicity will be discussed jointly with the ocean tide model for the region, the topographic features of the latter and the characteristics of the ice sheet's flow in it. A preliminary interpretation and its implications for the current knowledge on this particular environment will be presented.

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